

ment is 500 times more sensitive than the human eye using a Wood's lamp. They have also shown that the Fluoroscan is able to predict skin-flap survival in rats. In clinical and experimental studies, we have found it simple and reliable, using less than a tenth the dose of fluorescein we had formerly used for visual assessment with a Wood's lamp. Testing may be easily repeated at frequent intervals.

Another method is transcutaneous oxygen partial pressure ( $PO_2$ ) monitoring. Monitoring devices measure alterations of current in a polarographic cell induced by changes in  $PO_2$ . Most units contain a simple heating element to produce vasodilatation in the area being monitored. Thermal burns are therefore possible with prolonged monitoring at higher temperatures. Instruments that function at lower temperatures should eliminate this danger. Smith and associates have reported their experience with 65 replantations and 18 free tissue transfers. In failing replantations or free tissue transfers, changes in  $PO_2$  appeared several hours earlier than clinical changes or temperature changes. Our own experience has been similar.

With the increasing complexity of major reconstructive surgical procedures, we feel that these and additional noninvasive tissue monitoring techniques will have increasing clinical importance and applicability.

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## Applications of Free Flaps

MICROSURGICAL ANASTOMOSIS of small vessels has become an indispensable method of transferring living tissue for reconstruction. Continuing investigation of the circulatory anatomy of skin, muscle, fascia and bone is expanding the repertoire of donor sites and treatable problems. The overall success rate of transfers of free vascularized tissue exceeds 95% when performed by experienced teams. Microsurgical training is now a part of most plastic surgery residencies, and additional training is available through active fellowship programs.

There are two areas of free flap applications: wound closure and reconstruction. Wound closure applications were discussed in the plastic surgery "Epitome" series in the June 1982 issue. As an update, free flaps are being most regularly used in closing defects due to a surgical procedure, trauma, irradiation or infection where local flaps are unsuitable, unavailable or will not heal. Heretofore-untreatable wounds can now be reliably closed in one stage. For problem wounds of the foot and the distal third of the leg, where muscle mass is sparse and cutaneous circulation is poor, closure with free flaps is now considered the treatment of choice.

Free flaps have permitted ever-increasing possibi-

ties for reconstructive procedures. These applications include the following:

**Skin.** Thin flaps of skin alone can be transferred on direct cutaneous arteries to restore stability to large unstable scars. Some skin flaps (mostly from the back and extremities) have an identifiable sensory nerve that can be used to restore sensibility and are useful for reconstructing palmar and plantar defects.

**Soft tissue.** Serious soft tissue defects of the face due to injury, irradiation, hemifacial atrophy and craniofacial anomalies can be corrected. Flaps of muscle, omentum and de-epithelialized skin are used. For women who do not tolerate prostheses, free flaps of abdominal or buttock skin and fat have been used for breast reconstruction.

**Muscle.** Palsies of the face and hands, of many causes, can be reanimated by vascularized muscle transfers with motor neurotomy. The gracilis and foot muscles have been the most useful.

**Skeleton.** Management of large skeletal defects has been improved by the realization that bone healing is superior with vascularized rather than conventional grafts. Vascularized grafts of rib, ilium, fibula, scapula and metatarsal are often the preferred treatment for many defects of the mandible, femur, tibia and upper extremity.

**Viscera.** Defects of viscera, such as pharynx, trachea and ureter, have been reconstructed experimentally and clinically with transfers of soft tissues or other viscera such as jejunum or appendix. Many of these have been singular cases, but the value of pharyngoesophageal reconstruction with jejunum or colon has been established.

The most important recent development is the custom design of free flaps. Isolated vessels can be transposed underneath an otherwise random flap. As healing occurs, vascular continuity is established between flap and pedicle and the entire unit can then be transferred. This has been successful experimentally and clinically.

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## Use of Nasendoscopy in the Treatment of Velopharyngeal Insufficiency

PERSISTENT VELOPHARYNGEAL INSUFFICIENCY is variously described as occurring in up to 20% of any series following closure of a hard- or soft-palate cleft. Since 1876 the treatment of choice—though recently challenged by pharyngoplasty—has been creation of a pharyngeal flap. Though overall success following a